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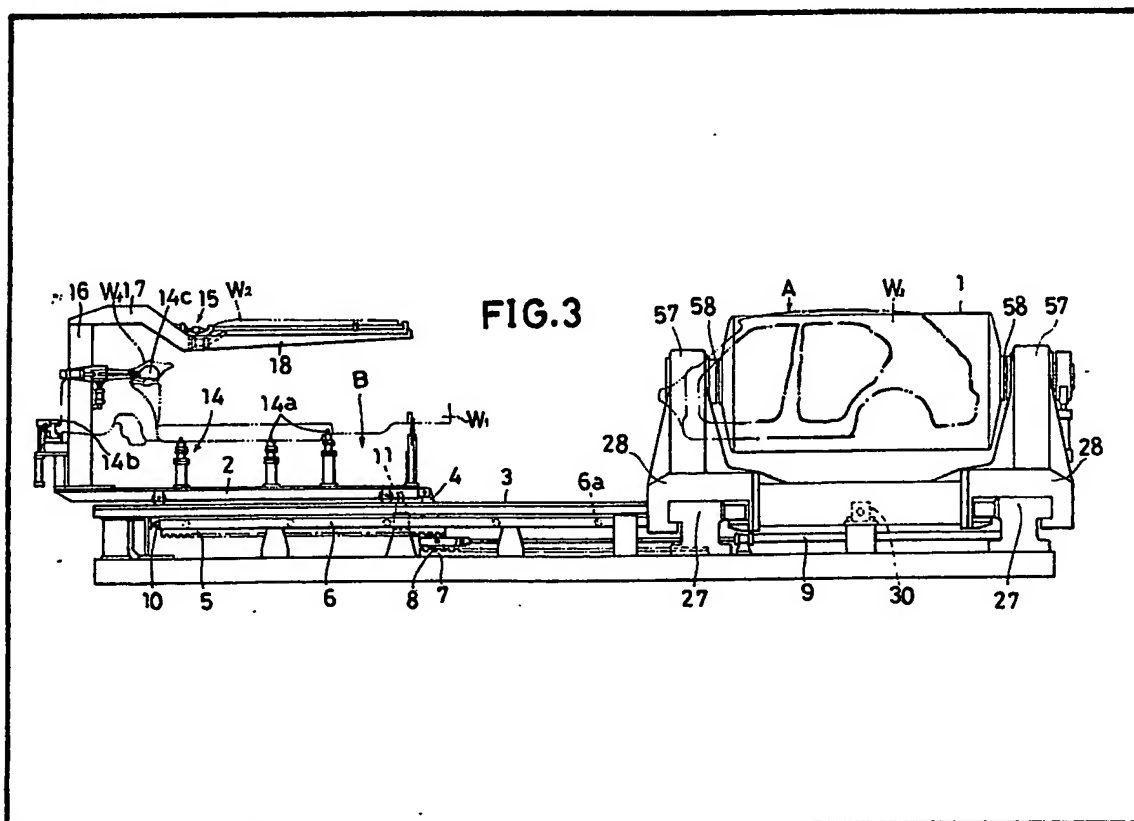
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## (54) Welding Motor Vehicle Bodies

(57) Apparatus is disclosed for welding together a floor panel ( $W_1$ ), a roof panel ( $W_2$ ) and spaced-apart side panels ( $W_3$ ). The apparatus comprises a positioning station (B), a combining station (A) and a carrier (2) movable between these stations and adapted for receiving at the positioning station for conveyance to the combining

station the floor panel and the roof panel. At the combining station there are two spaced-apart welding jig units (1, 1) each movable laterally and each arranged to receive and hold thereon one or other of the side panels for movement into abutment with the floor and roof panels when conveyed to the combining station, at which station the floor, roof and side panels are welded together. Positioning of the component panels is thus facilitated because only the floor and roof panels have to be positioned at the positioning station and this work can be carried out clear of the side panels which are positioned on the jig units.



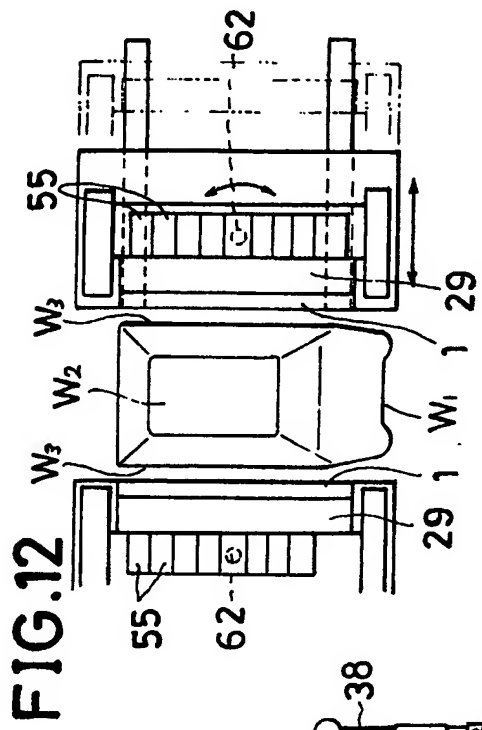
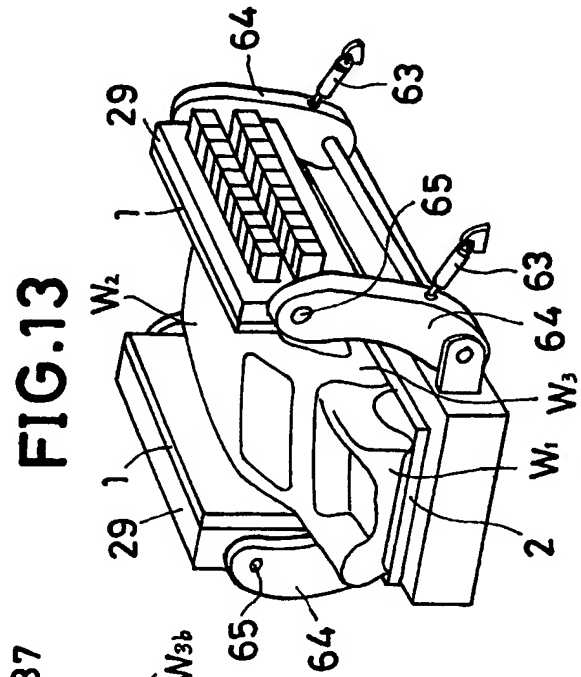
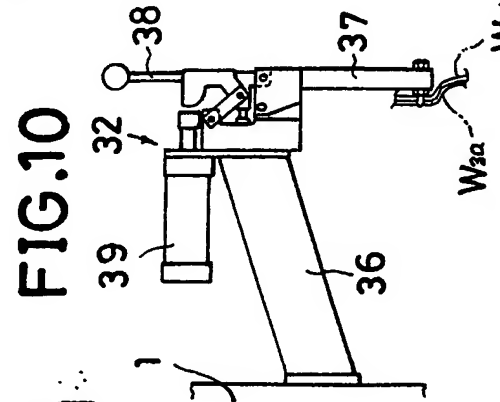
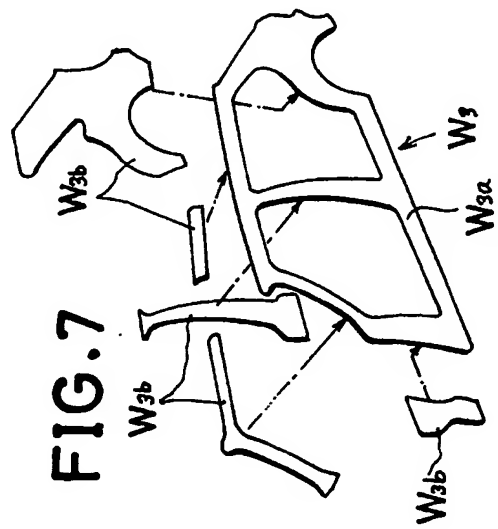
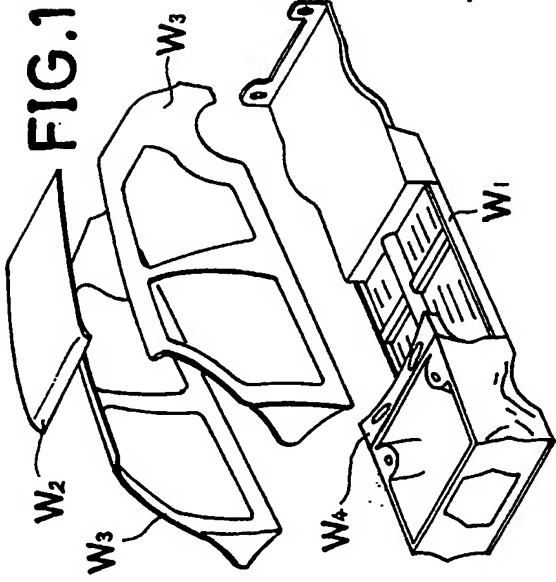
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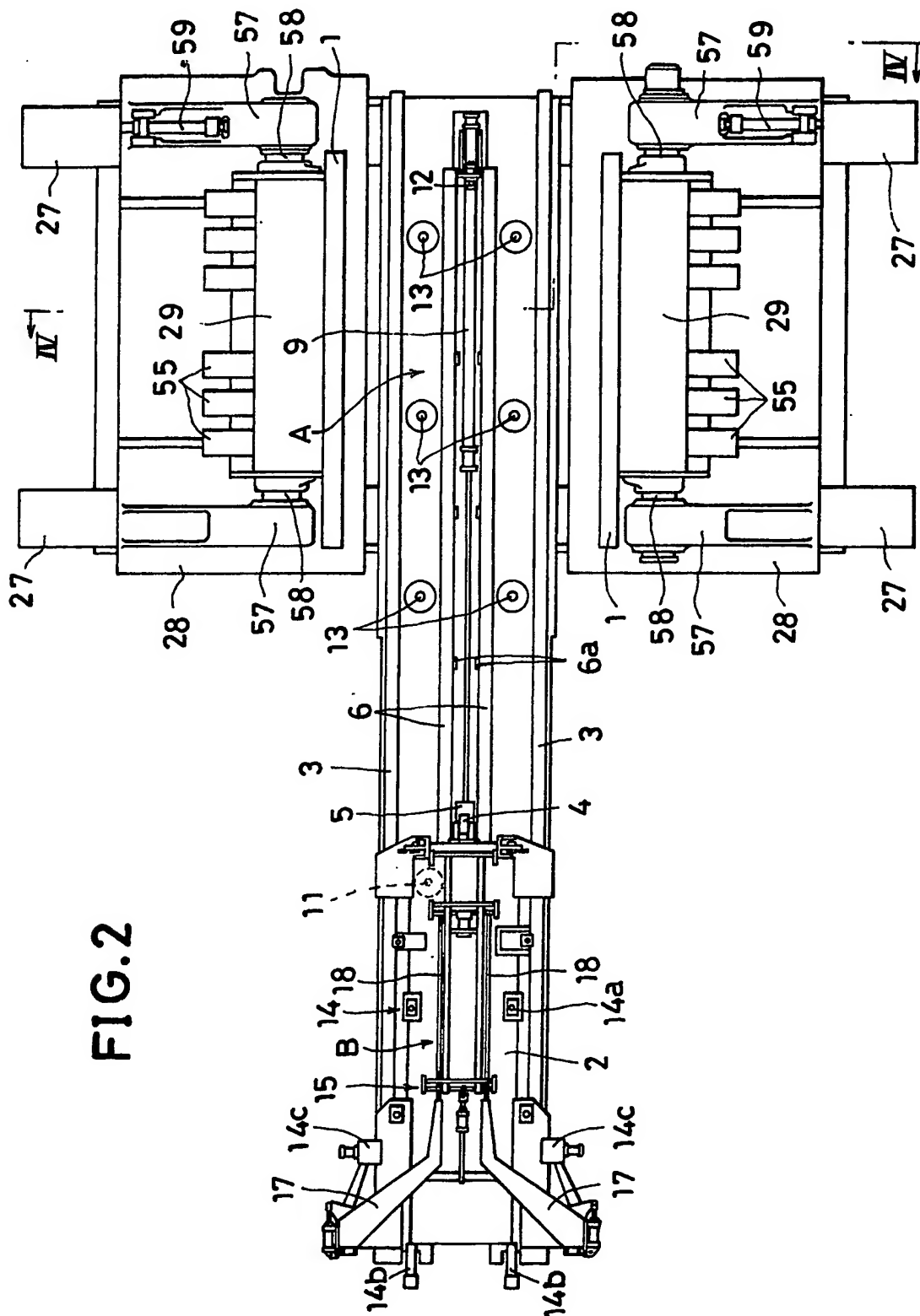
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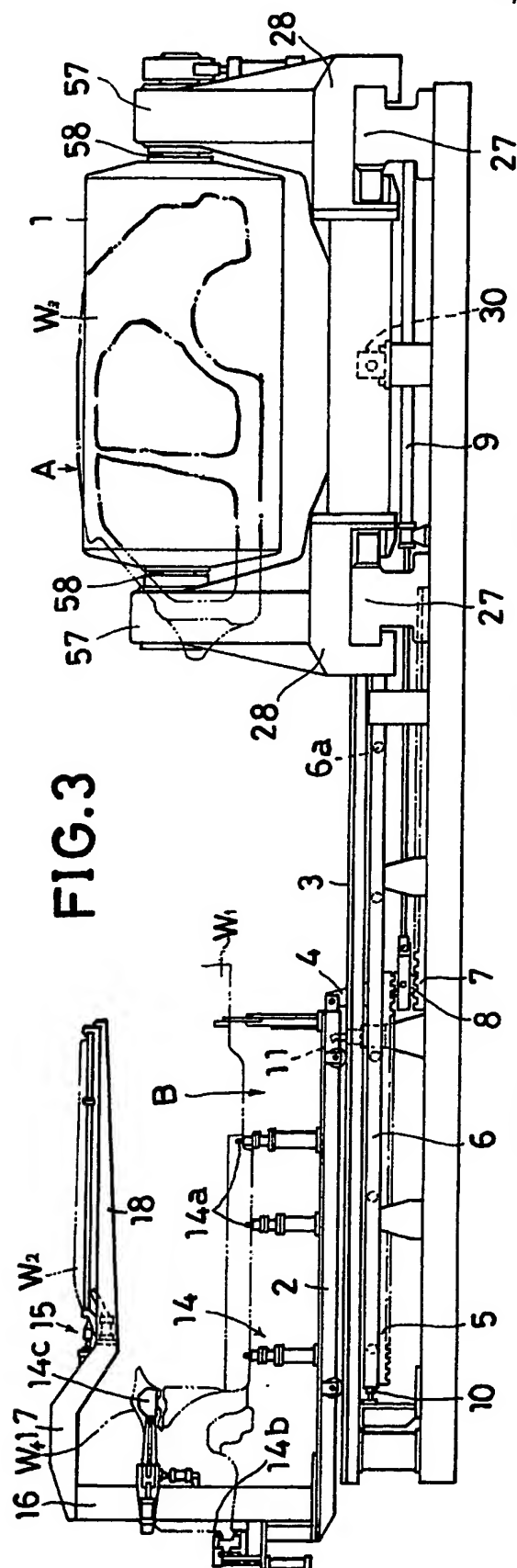
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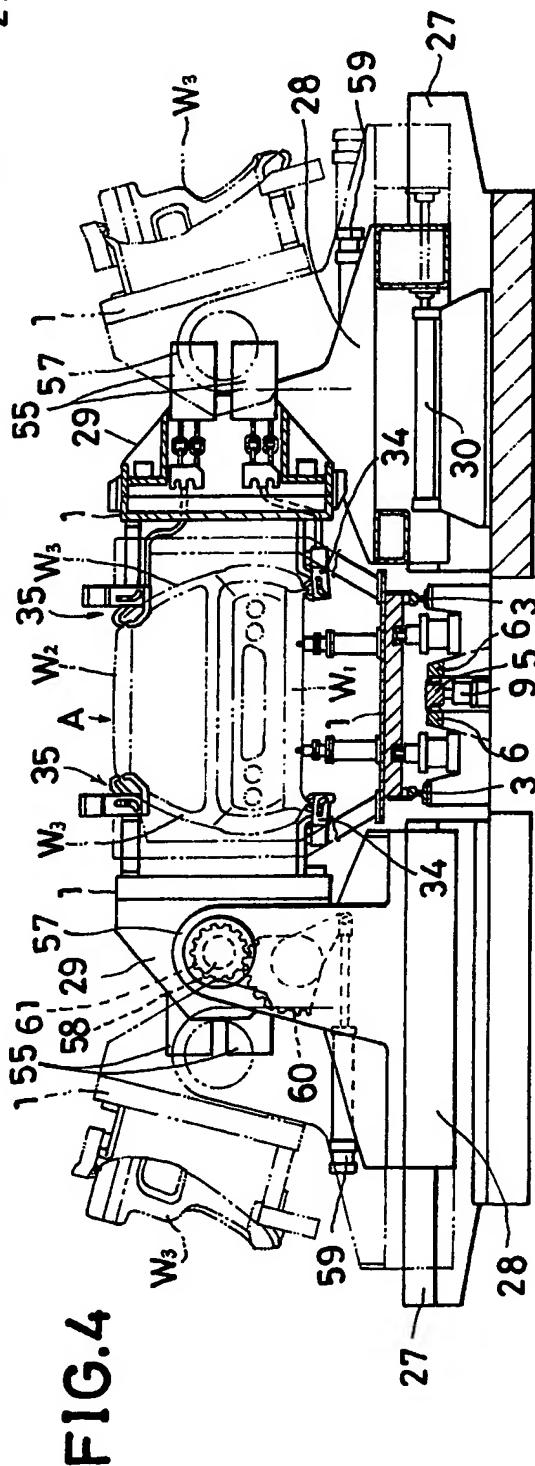
**FIG. 2**

3/7

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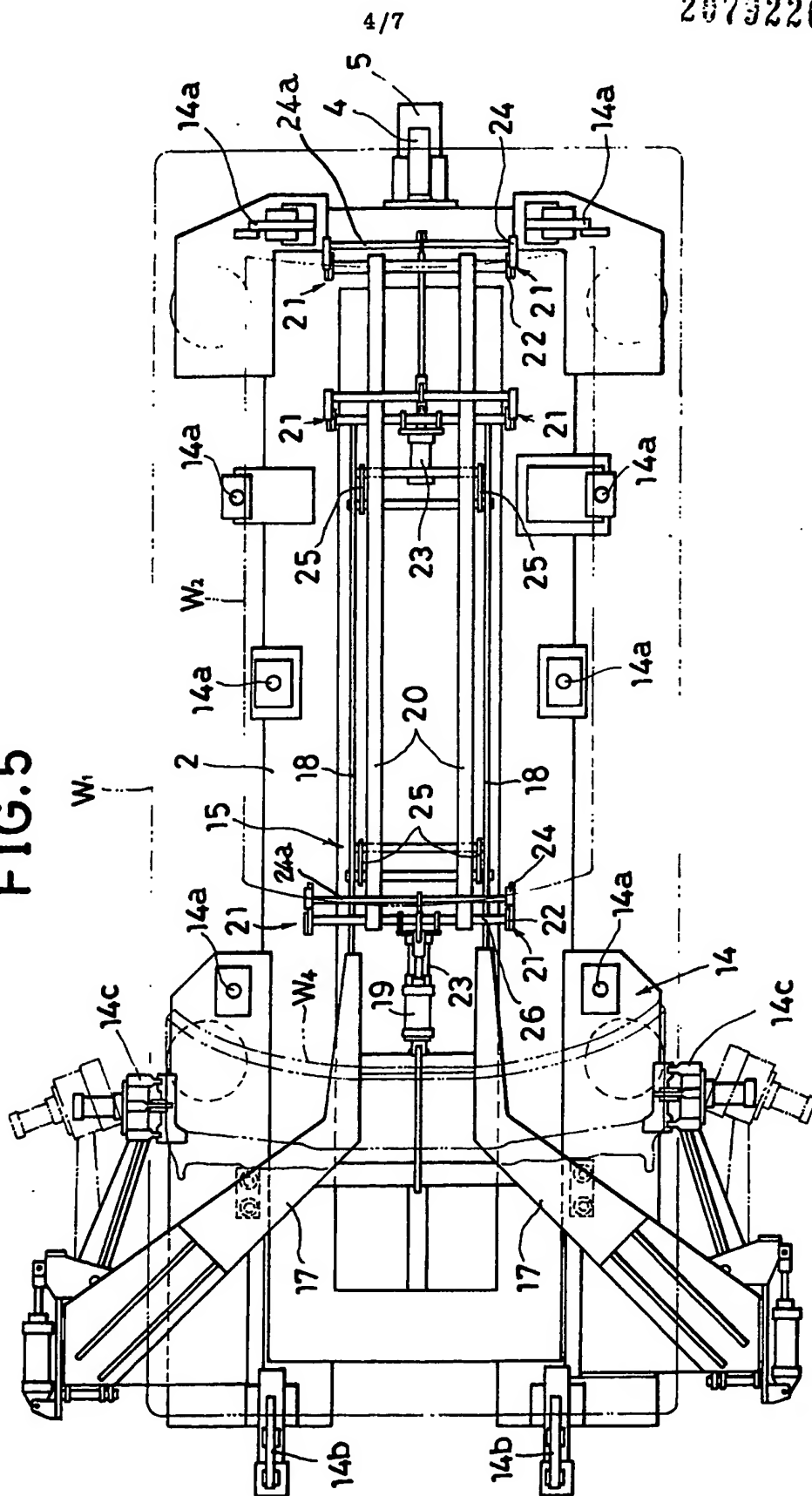
**FIG. 3**



**FIG. 4**

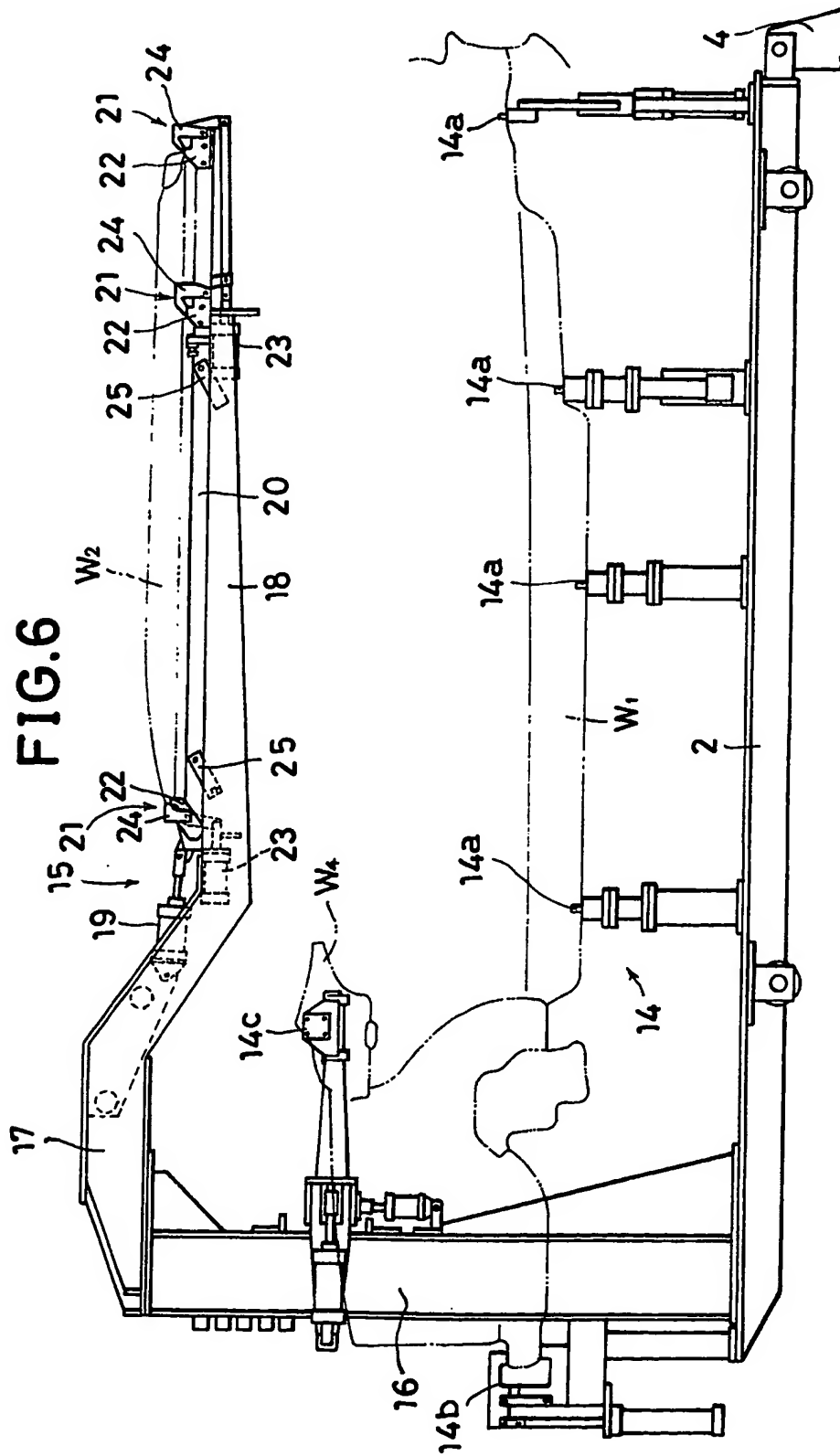
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FIG.5



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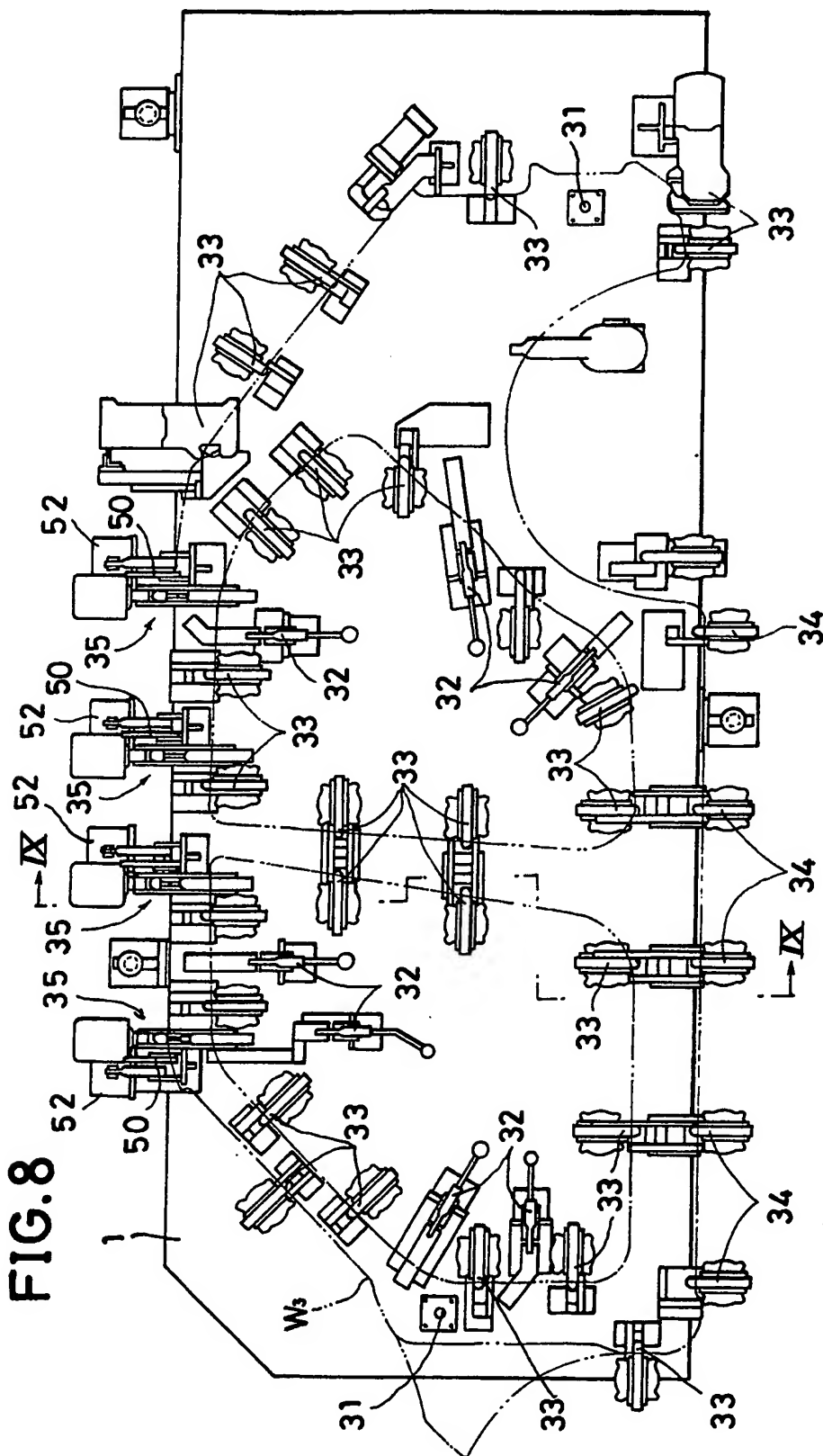
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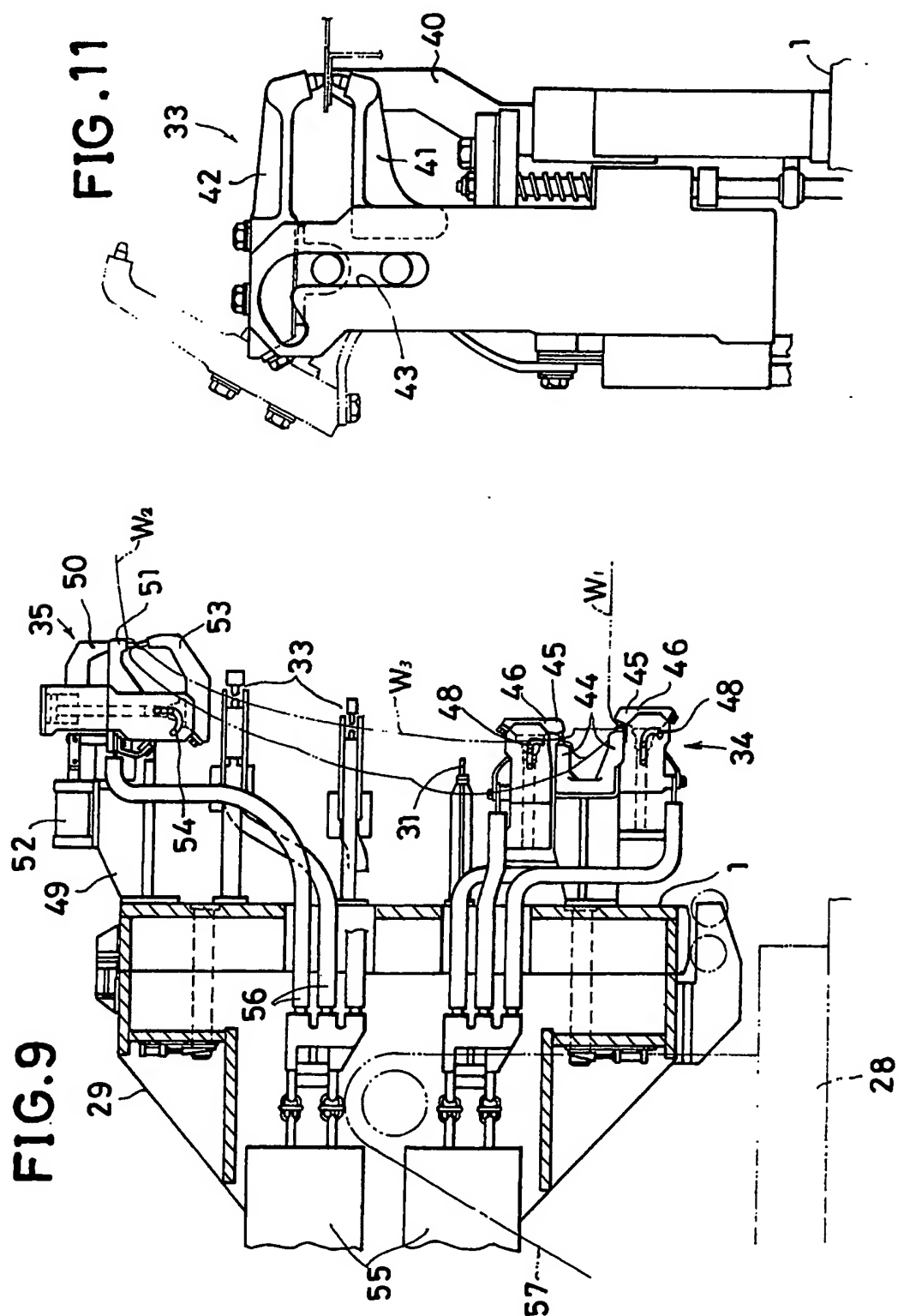
6/7

FIG. 8



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7/7





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# **SPECIFICATION** **Welding Apparatus**

This invention relates to welding apparatus. It is particularly concerned with apparatus for welding a motor vehicle body wherein component parts of the body, that is, a floor panel, a roof panel and a pair of opposite side panels are positioned and welded together at a combining station having at its lateral sides opposed welding jig units.

It has been usual hitherto with welding apparatus of this nature that the component parts are positioned in order on a carrier and are connected together temporarily by tack welding, and then the carrier is moved to the combining station and the temporarily connected component parts are welded together completely at that station. This is inconvenient in that working efficiency is low because the component parts are connected together temporarily before being welded together completely, and the apparatus is of complicated construction because the temporary assembled component parts have to be positioned before being welded together at the combining station.

According to the present invention there is provided welding apparatus for welding together a floor panel, a roof panel, and spaced-apart side panels of a motor vehicle body, the apparatus comprising a positioning station, a combining station and a carrier movable between these stations and adapted for receiving at the positioning station for conveyance to the combining station the floor panel and the roof panel, there being at the combining station two spaced-apart welding jig units each movable laterally and each arranged to receive and hold thereon one or other of the side panels for movement into abutment with the floor and roof panels when conveyed to the combining station, at which station the floor, roof and side panels are welded together. As the two welding jig units on the opposite outsides of the combining station are arranged to hold the respective side panels, and the carrier which is movable between the positioning station and the combining station is arranged to hold the floor panel and the roof panel, positioning of the component parts is facilitated because only the floor panel and the roof panel have to be positioned at the positioning station, and additionally, since the floor panel and the roof panel are conveyed by the carrier to the combining station and are combined at that station with the respective side panels already positioned on the respective welding jig units, working is improved, and positioning means provided can be simplified, and thus automation is facilitated.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:—

Figure 1 is an exploded perspective view of motor vehicle body component parts,

65 Figure 2 is a top plan view of welding apparatus,

Figure 3 is a side view of the apparatus of Figure 2,

70 Figure 4 is a sectional view taken along line IV—IV in Figure 2,

Figure 5 is an top plan view on a larger scale of a detail of the apparatus,

Figure 6 is a side view of the detail as shown in Figure 5,

75 Figure 7 is an exploded perspective view of one of the component parts of Figure 1,

Figure 8 is a front view on a larger scale of another detail of the apparatus,

80 Figure 9 is a sectional view taken along line IX—IX in Figure 8,

Figure 10 is a side view on a still larger scale of a member of the detail of Figure 9,

Figure 11 is a side view on a still larger scale of another member of the detail of Figure 9,

85 Figure 12 is a top plan view illustrating another form of welding invention apparatus, and

Figure 13 is a perspective view of a further form of welding apparatus.

Figure 1 shows component parts of a motor vehicle body, that is, a floor panel  $W_1$ , a roof panel  $W_2$  and opposed side panels  $W_3$ ,  $W_3$ . The floor panel  $W_1$  has thereon an upper dash portion  $W_4$ . As shown in Figures 2 and 4, these component parts  $W_1$ ,  $W_2$ ,  $W_3$ ,  $W_3$  are to be welded together in the welding apparatus at a combining station A by opposed welding jig units 1, 1 which are disposed on the sides of the combining station A.

In the apparatus illustrated the welding jig unit 1 on each side is movable laterally, and is arranged to position and hold the appropriate side panel  $W_3$ ; and there is provided a carrier 2 which is movable between the combining station A and a positioning station B. This carrier 2 is arranged to position and hold thereon the floor panel  $W_1$  and the roof panel  $W_2$ , placed in position at the station B. These positioned panels  $W_1$ ,  $W_2$  are carried by the carrier 2 to the combining station A where the side panel  $W_3$  on each side, previously positioned on the welding jig unit 1 on the corresponding side, is applied thereto from each lateral side thereof by lateral inward movement of each welding jig unit 1. Welding of all four panels is carried out under this condition.

In more detail, the carrier 2 is supported on rails 3, 3 installed along a travel path extending longitudinally between the combining station A and the positioning station B. In order to enable the carrier 2 to be reciprocated on the rails 3, 3 between the combining station A and the positioning station B, the carrier 2 is provided with a rack bar 5 connected thereto through a connecting member 4 provided on its end portion nearest the combining station A. The rack bar 5 is supported by guide bars 6, 6, extending along the travel path, via side rollers 6a, 6a attached to the opposite inside surfaces of the guide bars 6, 6, and there is provided an operation cylinder 9 having a gear wheel 8 which is meshed with the rack bar 5 and with a rack bar 7 fixed on a

machine base located below the rack bar 5.

The carrier 2 can be given a reciprocating motion by operating the operation cylinder 9. When the carrier 2 is moved to the positioning station B, the carrier 2 is located at this station B by a stop 10 which is provided at the end of the travel path remote from the combining station B and which comes into abutment with the rack bar 5. In addition a locating pin 11 is brought into engagement with an engaging hole (not illustrated) in the lower surface of the carrier 2. When the carrier 2 is moved to the combining station A, it is located by a stop 12 which is provided on the end of the travel path remote from the positioning station B and which comes into abutment with the rack bar 5, and by elevating locating pins 13 which engage in corresponding holes in the lower surface of the carrier 2. At the time of welding the carrier 2 is elevated to a predetermined height by the action of these pins 13.

As shown clearly in Figures 5 and 6, the carrier 2 is provided on its upper surface with floor panel positioning mechanism 14 for positioning and holding thereon the floor panel  $W_1$ , and is provided above the floor panel positioning mechanism 14 with a roof panel clamping mechanism 15 for positioning and clamping the roof panel  $W_2$  such that a space for each side panel  $W_3$  is left between the roof panel  $W_2$  and the floor panel  $W_1$ .

The floor panel positioning mechanism 14 includes pin members 14a arranged to be brought in engagement with corresponding holes (which are to serve as drain holes) in the floor panel  $W_1$ , two spaced-apart clamp members 14b, 14b for clamping one end edge portion of the panel  $W_1$  and two spaced-apart swingable clamp members 14c, 14c for clamping the upper dash portion  $W_4$  of the floor panel  $W_1$ .

In the illustrated example, as a result of considering facilitating positioning of the floor panel  $W_1$  in relation to the side panel  $W_3$  on each side, the roof panel clamping mechanism 15 is so constructed that the roof panel  $W_2$  clamped thereby is movable upwards and downwards. To this end the clamping mechanism 15 includes a supporting frame 20 which is long in the longitudinal direction and is so provided, between two spaced-apart brackets 18, 18 attached to arm members 17, 17 extending from the upper end portions of two spaced-apart supporting pillars 16, 16 provided on the carrier 2, as to be movable upwards and downwards by operation of a piston and cylinder arrangement 19 supported between the arm members 17, 17. Pairs of spaced-apart clamp members 21, 21 are disposed on the supporting frame 20 at suitable longitudinal intervals. Each of these clamp members 21 comprises a receiving member 22 for receiving the roof panel  $W_2$  and a clamp claw 24 which is opened and closed by operation of a corresponding piston and cylinder arrangement 23 supported on the supporting frame 20.

The supporting frame 20 is supported for its upwards and downwards movement by front and rear parallel links 25, 25. A connecting rod 26 provided on the pillar 16 end of the supporting frame 20 is connected to a piston rod of the piston and cylinder arrangement 19 so that the supporting frame 20 may be moved upwards and downwards by the operation of the arrangement 19. Further, a connecting rod 24a connecting between the clamp claws 24, 24 of each pair of clamp members 21, 21 is connected to a piston rod of each corresponding piston and cylinder arrangement 23 so that the clamp claws 24, 24 are operated by operation of the arrangements 23, 23.

As far as the clamp members 21 are concerned, it is enough to provide two pairs thereof, that is, one pair thereof at the front and another pair at the rear. If, however, three pairs thereof as shown in Figures 5 and 6, or more than that, are provided, it is advantageous in that different kinds of roof panel  $W_2$ , which are different in length for a change in model, can be clamped thereby.

The welding jig unit 1 on each side is fixedly provided on a mounting base 29 provided on a movable base 28 which is supported slidably in a lateral direction on two spaced-apart guide bars 27, 27 extending laterally and outwards from the combining station A. Each unit 1 is movable together with the movable base 27 by operation of a piston and cylinder arrangement 30 connected to the movable base 28.

The side panel  $W_3$  for each side includes an outer part  $W_{3a}$  and several inner parts  $W_{3b}$  which are to be welded to the inner surface of the outer part as shown in Figure 7. It is optional that these parts are previously welded together and the resultant side panel  $W_3$  is positioned and held on the welding jig unit 1 by positioning pins 31. In the illustrated example, however, in order that the outer part  $W_{3a}$  and the inner parts  $W_{3b}$  may be welded together to form the side panel  $W_3$  on the welding jig unit 1, as shown in Figures 8 and 9, the welding jig unit 1 is provided thereon with a clamp mechanism including clamp members 32, 32... for clamping together the inner parts  $W_{3b}$  and the outer part  $W_{3a}$  which is previously positioned by the positioning pins 31, and a first welding mechanism including welding members 33, 33... for welding together these parts  $W_{3a}$ ,  $W_{3b}$  under their clamped condition to form the side panel  $W_3$ . The welding jig unit 1 is additionally provided thereon with a second welding mechanism including welding members 34, 34... for welding the side panel  $W_3$  under its positioned condition to the floor panel  $W_1$  held on the carrier 2, and a third welding mechanism including welding members 35, 35... for welding the side panel  $W_3$  to the roof panel  $W_2$  held on the carrier 2.

Each of the clamp members 32, 32... is as shown in Figure 10 and includes a clamp arm 37 pivotally provided on a bracket 36 projecting from the welding jig unit 1, an operation handle 38

pivotaly provided on the arm 37 and having a toggle joint type moving mechanism, and a piston and cylinder arrangement 39 for releasing the handle 38.

- 5 Each of the welding members 33, 33, . . . of the first welding mechanism is as shown in Figure 11 and includes a receiving member 40 attached to the welding jig unit 1 through a bracket and a welding gun 41. A movable gun arm 42 of the welding gun 41 is opened and closed while being guided by a guide opening 43.

- 10 Each of the welding members 34, 34, . . . of the second welding mechanism is as shown in Figure 9 and includes a receiving member 44 of yoke form attached through a bracket to the welding jig unit 1 and a welding gun 45. A movable gun arm 46 of the welding gun 45 is opened and closed while being guided by a guide opening 48.

- 15 Each of the welding members 35, 35, . . . of the third welding mechanism is as shown in Figure 9 and includes a clasper 50 supported on a bracket 49 projecting from the welding jig unit 1 and a welding gun 51. A clamp arm of the clasper 50 is constructed to be clamped in parallel with a stationary gun arm of the welding gun 51 by operation of a piston and cylinder arrangement 52. A movable gun arm 53 of the welding gun 51 is opened and closed while being guided by a guide opening 54.

- 20 Numeral 55 denotes transformers mounted on the mounting base 29 and electrically connected to the first, the second and the third welding mechanisms.

- 25 It is not good for proper working that the welding jig unit 1 on each side should remain in its inwardly facing position while the outer part  $W_{3a}$  and the inner part  $W_{3b}$  for forming the side panel  $W_3$  are set thereon and welded together to form the side panel  $W_3$ . Inconvenience is involved if the side panel  $W_3$  previously formed is set on the unit 1 while so positioned. Accordingly, in order to avoid such inconveniences, in the illustrated example the mounting base 29 for each welding jig unit 1 is pivotaly supported by a rotatable shaft 58 on spaced-apart supporting arms 57, 57 standing upright on the movable base 28. A gear sector 60 moved by operation of a piston and cylinder arrangement 59 provided on the movable base 28 is in meshed engagement with a ring gear 61 fast on the shaft 58 so that by operation of the piston and cylinder arrangement 59 the mounting base 29 and, accordingly, the welding jig unit 1 fixed thereto may be given a reciprocal turning movement between its inwardly facing position and an outwardly facing position. Thus, the work of forming the side panel  $W_3$  on the unit 1 can be carried out under the condition that the unit 1 faces outwards as shown by chain lines in Figure 4.

- 30 A mechanism for turning the welding jig unit 1 is not limited to the above, and may be, for instance, as shown in Figure 12 in which the mounting base 29 is provided turnably on the movable base 28 through a shaft 62 connected to

- 65 the lower surface thereof so that the base 29 may be rotated about the shaft 62.

- Figure 13 shows a further modification in which each mounting base 29 is supported by spaced-apart swing arms 64, 64 which are swingable by respective piston and cylinder arrangements 63 so that the welding jig units 1 are moved inwards and outwards. In this case, each mounting base 29 is pivotaly supported on its swing arms 64, 64 through a shaft 65, so that the welding jig unit 1 is turnable.

Operation is as follows:—

- At the positioning station B the floor panel  $W_1$  and the roof panel  $W_2$  are positioned and clamped on the carrier 2 located at the positioning station B. At the combining station A the welding jig unit 1 on each side is moved outwards and is turned to its outwardly facing position, and the outer part  $W_{3a}$  and the inner parts  $W_{3b}$  for the side panel  $W_3$  on each side are clamped on the appropriate welding jig unit 1, and the welding members 33 of the first welding mechanism are operated under their clamped condition so as to form the side panel  $W_3$ . During this operation, the carrier 2 on which positioning of the floor panel  $W_1$  and the roof panel  $W_2$  has been completed is moved to the combining station A, and is positioned in height by using the elevating locating pins 13 at the combining station A. Each welding jig unit 1 on which the forming of the side panel  $W_3$  is completed is turned to its inwardly facing position and is then moved inwards so far as to bring the side panel  $W_3$  held thereon into abutment with the floor panel  $W_1$  held on the carrier 2. Under this abutment condition between the two panels  $W_1$ ,  $W_3$  on each side, the welding members 34 of the second welding mechanism are operated and thereby the floor panel  $W_1$  and the side panel  $W_3$  are welded together. Thereafter, the roof panel  $W_2$  held on the carrier 2 is brought into abutment with the side panel  $W_3$  on each side, the supporting frame 20 and with it the clamping mechanism 15 supporting the roof panel  $W_2$  being moved downwards by operation of the piston and cylinder arrangement 19, and under the abutment condition between the two panels  $W_2$ ,  $W_3$  on each side the welding members 35 of the third welding mechanism are operated and thereby the roof panel  $W_2$  and the side panel  $W_3$  are welded together. Thus, the welding process is completed to form a motor car body.

- Thus, in the apparatus described, the two welding jig units on the opposite outsides of the combining station are arranged to hold the respective side panels, and the carrier which is movable between the positioning station and the combining station is arranged to hold the floor panel and the roof panel, positioning of the component parts is facilitated because only the floor panel and the roof panel have to be positioned at the positioning station, and additionally, since the floor panel and the roof panel are conveyed by the carrier to the combining station and are combined at that

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GB 2 079 226 A 4

station with the respective side panels already positioned on the respective welding jig units, working is improved, and positioning means provided can be simplified, and thus automation is facilitated.

#### Claims

1. Welding apparatus for welding together a floor panel, a roof panel and spaced-apart side panels of a motor vehicle body, the apparatus comprising a positioning station, a combining station and a carrier movable between these stations and adapted for receiving at the positioning station for conveyance to the combining station the floor panel and the roof panel, there being at the combining station two spaced-apart welding jig units each movable laterally and each arranged to receive and hold thereon one or other of the side panels for movement into abutment with the floor and roof panels when conveyed to the combining station, at which station the floor, roof and side panels are welded together.

2. Welding apparatus as claimed in claim 1, wherein the carrier is provided with a floor panel

25 positioning means for positioning the floor panel, and a roof panel clamping means for clamping the roof panel so that the roof panel is movable upwards and downwards for providing a closable space for the side panel on each side between the roof panel and the floor panel positioned by the floor panel positioning means.

3. Welding apparatus as claimed in claim 1 or 2, wherein the welding jig unit on each side is provided with a clamping means for clamping component parts of the side panel, a first welding means for welding together these component parts to form the side panel, a second welding means for welding the side panel to the floor panel, and a third welding means for welding the side panel to the roof panel.

4. Welding apparatus as claimed in claim 1, 2 or 3, wherein the welding jig unit on each side is turnable between an inwardly facing position and an outwardly facing position.

5. Welding apparatus substantially as hereinbefore described with reference to Figures 1 to 11, or Figure 12, or Figure 13 of the accompanying drawings.

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